VEGETATION AND SOIL ANALYSES
NORTH LILY PROJECT
JUAB COUNTY, UTAH

Prepared For:

Lee Mining Corp.
861 S. 725 West
Orem, UT 84058

Prepared By:

NPI
417 Wakara Way
Salt Lake City, UT 84108

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July 25, 1984

The North Lily project near Eureka, Utah in Juab County was visited on the 10th of July for an initial site visit. During that visit sampling sites were located in two vegetation types that are characteristic of the area. On the 11th and 12th of July cover data were collected from each type. Soil samples were made from the proposed topsoil borrow area and returned to NPI soils laboratory for analysis. Contact was made with Mr. Evert Harper and Mr. Steve Cox regarding soil parameters required and overall vegetation sampling methodology recommendations. The procedures used follow those outlined in "Vegetation Information Guidelines for Permanent Program Submission for Coal Mines" pursuant to SMC 779.19 and UmC 783.19 requirements and prepared by the State of Utah, Department of Natural Resources, Division of oil, Gas and Mining. Dr. Dennis Hansen, Manager of Reclamation Services at NPI conducted the field data survey.

Vegetation Types

Two maps are included in the report (Figures 1 and 2). At a scale of 1:24,000, Map 1 shows the general location of the project. The second map (1:6,000) shows a detail of the project site with the borrow area and tailings site delineated and soil sample sites marked. Two vegetation types were sampled, a sagebrush type and a mixed shrub type. The sagebrush vegetation type is typical of the borrow area delineated in Figure 2. The site is typically a mature sagebrush community with an abundance of annual grasses, primarily cheatgrass. Previous land disturbance includes abandoned railroad beds and old roads. The tailings area is characterized by a mixed shrub community. sagebrush, rabbitbrush, and bitterbrush account for the majority of plant cover with sime intermingling forbs and grasses. Buildings, roads and other previous mining disturbance occur throughout the site. Whitetop, a pernicious weed, was commonly found in disturbed areas. Both areas provide cover and food for wildlife. Deer use the mixed shrub area as primarily winter range, although, some use was observed during the field survey.

Methodology

The percentage of ground cover attributable to vegetation was determined using ocular estimates. Vegetative cover was estimated to the nearest 1% for each species encountered, for bareground and litter by randomly placing 40 1m

x 1m quadrats. A grid was superimposed on both areas and a set of 40 random numbers were selected from a random numbers table to select the placement of the quadrats in each area. Due to the heterogeneity of the areas, primarily due to previous disturbances, a maximum sample size was anticipated.

Sample adequacy was determined, for cover only, after 30 quadrats were sampled. The formula used was:

$$N_{mm} = \frac{t^2 s^2}{(d\bar{x})^2}, \text{ where } t = 1{,}282,$$

s=the standard deviation, d=.10 and x=the sample mean, in this case total vegetation cover (Vegetation Guidelines, page 5). Table 1 shows the results of sample adequacy tests after 30 quadrats had been sampled. Based on the results shown in Table 1, a maximum sample size of 40 was set for both vegetation types.

Results

The amount of cover by species is presented in Table 2. for the sagebrush vegetation type. Shrubs accounted for 89% of th3 26.6% vegetative cover, grasses approximately 4%, and forbs 7%. Over 50% of the site was void of perennial vegetation (bareground), a total of 16 species were observed on site, 3 shrubs, 10 forbs, and 3 perennial grasses.

The mixed shrub vegetation type characteristic of the tailings area had only 16% vegetative cover (Table 3) as compared to nearly 27% in the sagebrush type. The low average cover is due, in part, to the numerous land disturbances that have occurred during previous mining activities. Of the 16% cover nearly 80% is composed of shrubs, only 4% of perennial grasses and the rest forbs. Forb cover is made up almost entirely of ragweed and whitetop. Eighteen species were observed in the mixed shrub type, four shrubs, nine forbs, and five perennial grasses. No threatened or endangered species were encountered nor are suspected to occur on either of the sites.

Soil samples were taken at four sites in the proposed topsoil borrow area to determine soil suitability. At each site soil samples were taken at 0-6"

depth, 2' depth, 4' depth, and 6' depth. Each soil sample was analyzed for water soluble Ca, Mg, and Na; electrical conductivity (EC), pH, and texture, from which saturation percentage (SP), and sodium adsorption ratio (SAR) were determined. The parameters sampled are as outlined in UMC 817.22(e)(1)(i) and required by the Division of Oil, Gas and Mining. Results of the soil analyses are presented in Table 4. Sample numbers refer to sites 1-4 (see Figure 2) and soil sample depth, A-D. A represents the 0-6" depth, B the 2' depth, C the 4' depth, and D the 6' depth.

The pH of a saturated paste, electrical conductivity of saturation extracts, and the SAR as derived from the soluble cations, calcium, magnesium, and sodium, are all parameters which define saline and alkali soils.

The SAR is related to exchangeable-sodium-percentage (ESP) as per Figure 27, "Diagnosis and Improvements of Saline and Alkali Soils" (USDA Agriculture Handbook No. 60, p. 103, Figure 3). The ESP is a parameter defining alkali soils.

Soils with an EC value less than 4 mmhos/cm and an ESP value less than 15 are considered normal with respect to soil salinity. They are not problematic. All soils sampled fall into this category.

Soil Suitability

The suitability of the soils sampled as a substitute topsoil is based on criteria outlined by the Wyoming Department of Environmental Quality, Land Quality Division, Guuideline No. 1, Topsoil and Overburden Draft, p. 18 (Attachment 1). The parameters measured of those listed include pH, EC, texture, sodium adsorption ratio (SAR), and saturation percentage (SP). Table 5 lists each soil sample as to its suitability based on those criteria.

The results show that all soils would be suitable. The soils at the 6' depth show an increase in pH which lowers the soil suitability rating to fair for all four sites sampled. However, at the 4' depth all soils are within the good suitability rating.

Table 1. North Lily project. Summary of sample adequacy considerations.

Parameter Type	Quality	Mean (x)	SD (s)	t-value	d-value	Nmin
Total Cover Sagebrush	30	23.93	17.3760	1.282	.1	87
Total Cover Mixed Shrub	30	14.20	17.0120	1.282	.1	236

Table 2. North Lily project. Summary of cover data and species list, sagebrush vegetation type.

Shrubs	% Cover	S.D.	% Frequency	% of Total
Artemesia tridentata	23.60	19.59	95	86
Chrysothamnus viscidiflorus	.48	1.7811	18	2
Opuntia sp.	.25	1.5811	3	1
Forbs				
Centaurea virgata	.88	4.7404	13	3
Chaenactis douglasii	.03	.1581	3	<1
Cirsium sp.	.04	.1594	13	<1
Gilia aggregata	.03	.1585	5	<1
Hedysarum sp.	.08	.3495	10	<1
Lactuca serriola	.03	.1585	20	<1
Phlox hoodii*				
Sphaeralcea spp.	.09	.3490	15	<1
Tragopogon dubius	.01	.0221	5	<1
Zygadenus sp.	.03	.1581	3	<1
Grasses				
Agropyron smithii	.73	1.5155	35	3
Oryzopsis hymenoides	.03	.1581	3	<1
Sitaniion hystrix	.40	1.0813	18	1
Total Vegetative Cover	26.62	18.8920		
Bareground	52.35	24.6395		
Litter and Rock	20.85	21.5770		

*Observed on site, but not encountered in quadrats.

Table 3. North Lily project. Summary of cover data and species list, mixed shrub vegetation type.

Shrubs	% Cover	S.D.	% Frequency	% of Total
Artemesia tridentata	6.26	16.3793	30	39
Chrysothamnus nauseosus	4.80	12.1764	30	30
C. viscidiflorus	.35	1.1668	10	2
Purshia tridentata	1.20	4.9933	10	8
Forbs				
Cardaria draba	.25	1.5811	3	2
Castilleja spp.*				
Centaurea virgata	2.30	5.6441	25	14
Chaenactis douglasii	.03	.0158	3	<1
Cirsium vulgare	.06	.3162	8	<1
Lactuca serriola	.03	.1588	8	<1
Sphaeralcea spp.	.03	.0158	3	<1
Tragopogon spp.	.01	.0221	5	<1
Verbascum thapsus	.03	.0158	3	<1
Grasses				
Agropyron smithii*				
Agropyron spicatum	.25	1.5811	3	2
Distichlis stricta	.03	.1581	3	<1
Oryzopsis hymenoides	.05	.3162	3	<1
Poa pratensis	.25	1.1036	5	2
Total Vegetative Cover	16.05	20.3847		
Bareground	58.35	31.6111		
Litter and Rock	24.80	29.9959		

*Observed on site, but not encountered in quadrats.

Table 4. North Lily project. Results of soil analysis.

SOIL ANALYSIS RESULTS

Sample No.	pH*	EC** (mmhos)	Saturation %
S1A	7.40	0.44	43
S1B	8.11	0.29	43
S1C	8.30	0.32	47
S1D	8.53	0.45	42
S2A	7.31	0.74	37
S2B	7.66	0.48	52
S2C	8.18	0.27	40
S2D	8.43	0.27	51
S3A	7.66	0.45	47
S3B	8.28	0.25	45
S3C	8.35	0.26	46
S3D	8.66	0.49	40
S4A	7.36	0.32	44
S4B	8.22	0.22	49
S4C	8.34	0.25	43
S4D	8.52	0.32	39

*Method: Saturated Paste
**Method: Saturated

Table 4. Continued.

PARTICLE SIZE ANALYSIS

Sample No.	% Sand	% Clay	% Silt	Texture
S1A	42.4	17.4	40.2	Loam
S1B	35.2	17.4	47.4	Loam
S1C	36.4	17.4	46.2	Loam
S1D	46.4	13.4	40.2	Loam
S2A	50.4	15.8	33.8	Loam
S2B	30.4	20.8	48.8	Loam
S2C	46.4	15.8	37.8	Loam
S2D	34.4	18.8	46.8	Loam
S3A	46.0	15.2	38.8	Loam
S3B	34.0	20.2	45.8	Loam
S3C	30.0	19.2	50.8	Silt Loam
S4C	38.0	18.2	43.8	Loam
S1A	36.0	17.2	46.8	Loam
S1B	32.0	20.2	47.8	Loam
S1C	38.0	18.2	43.8	Loam
S1D	51.6	15.2	33.2	Loam

Table 4. Continued.

SOLUABLE CATIONS/SAR

Sample No.	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR
S1A	3	1	<1	<1
S1B	5	1	1	1
S1C	2	1	1	1
S1D	2	2	2	1
S2A	5	3	<1	<1
S2B	3	1	1	1
S2C	2	1	1	1
S2D	1	1	1	1
S3A	3	1	<1	<1
S3B	7	1	1	1
S3C	2	2	1	1
S3D	4	1	4	3
S4A	2	1	<1	<1
S4B	15	2	<1	<1
S4C	4	2	<1	<1
S4D	1	2	<1	<1

Table 5. North Lily project. Soil suitability analysis.

Sample #	Depth	pH	EC (mmhos)	SP	Texture	SAR
S1A	0-6"	Good	Good	Good/Fair	Good	Good
S1B	2'	Good	Good	Good/Fair	Good	Good
S1C	4'	Good	Good	Good/Fair	Good	Good
S1D	6'	Fair	Good	Good/Fair	Good	Good
S2A	0-6"	Good	Good	Good/Fair	Good	Good
S2B	2'	Good	Good	Good/Fair	Good	Good
S2C	4'	Good	Good	Good/Fair	Good	Good
S2D	6'	Fair	Good	Good/Fair	Good	Good
S3A	0-6"	Good	Good	Good/Fair	Good	Good
S3B	2'	Good	Good	Good/Fair	Good	Good
S3C	4'	Good	Good	Good/Fair	Good	Good
S3D	6'	Fair	Good	Good/Fair	Good	Good
S4A	0-6"	Good	Good	Good/Fair	Good	Good
S4B	2'	Good	Good	Good/Fair	Good	Good
S4C	4'	Good	Good	Good/Fair	Good	Good
S4D	6'	Fair	Good	Good/Fair	Good	Good

Figure 3. From USDA Agriculture Handbook, No. 60, p. 103.

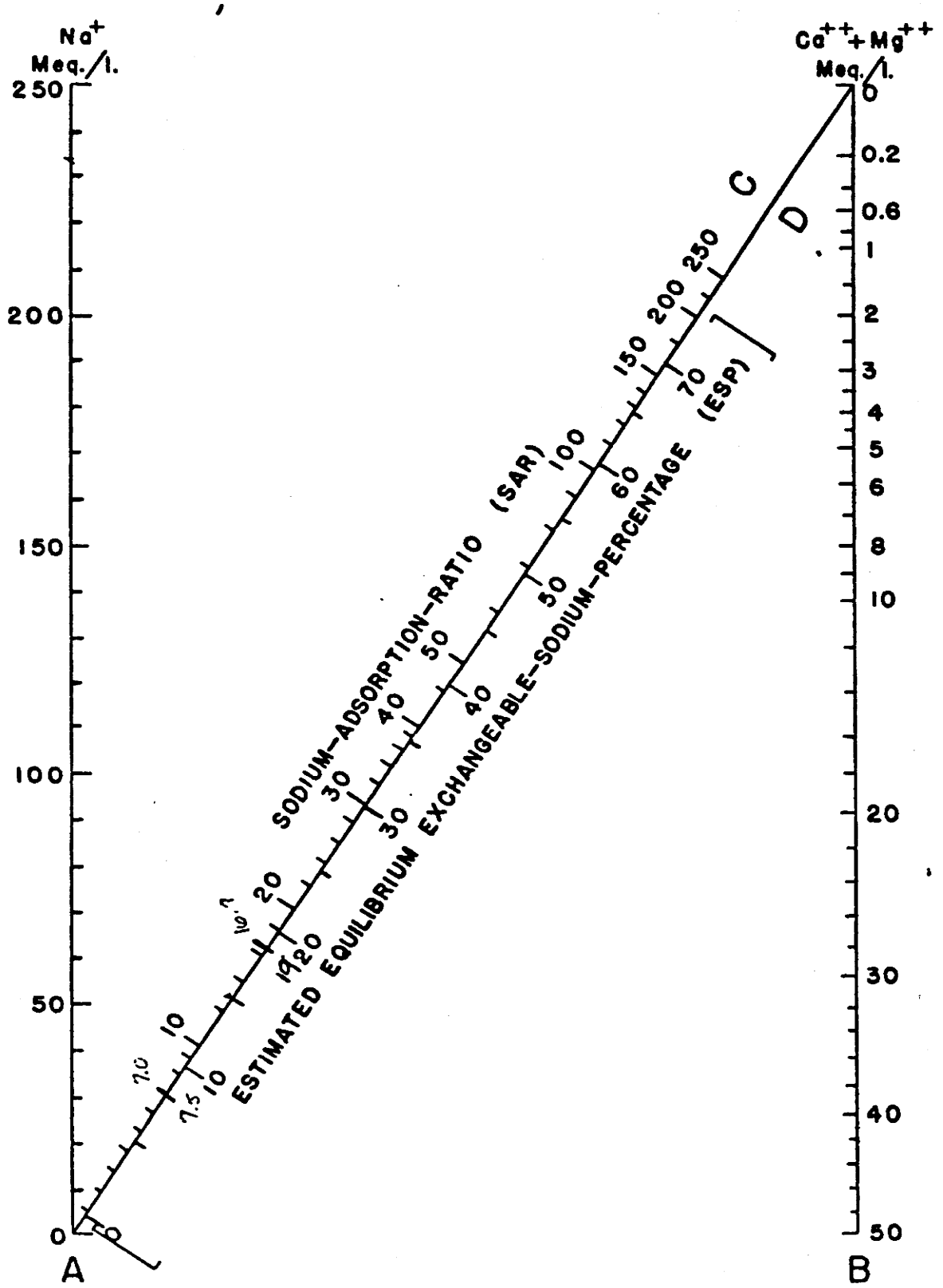

FIGURE 27.—Nomogram for determining the *SAR* value of a saturation extract and for estimating the corresponding *ESP* value of soil at equilibrium with the extract.

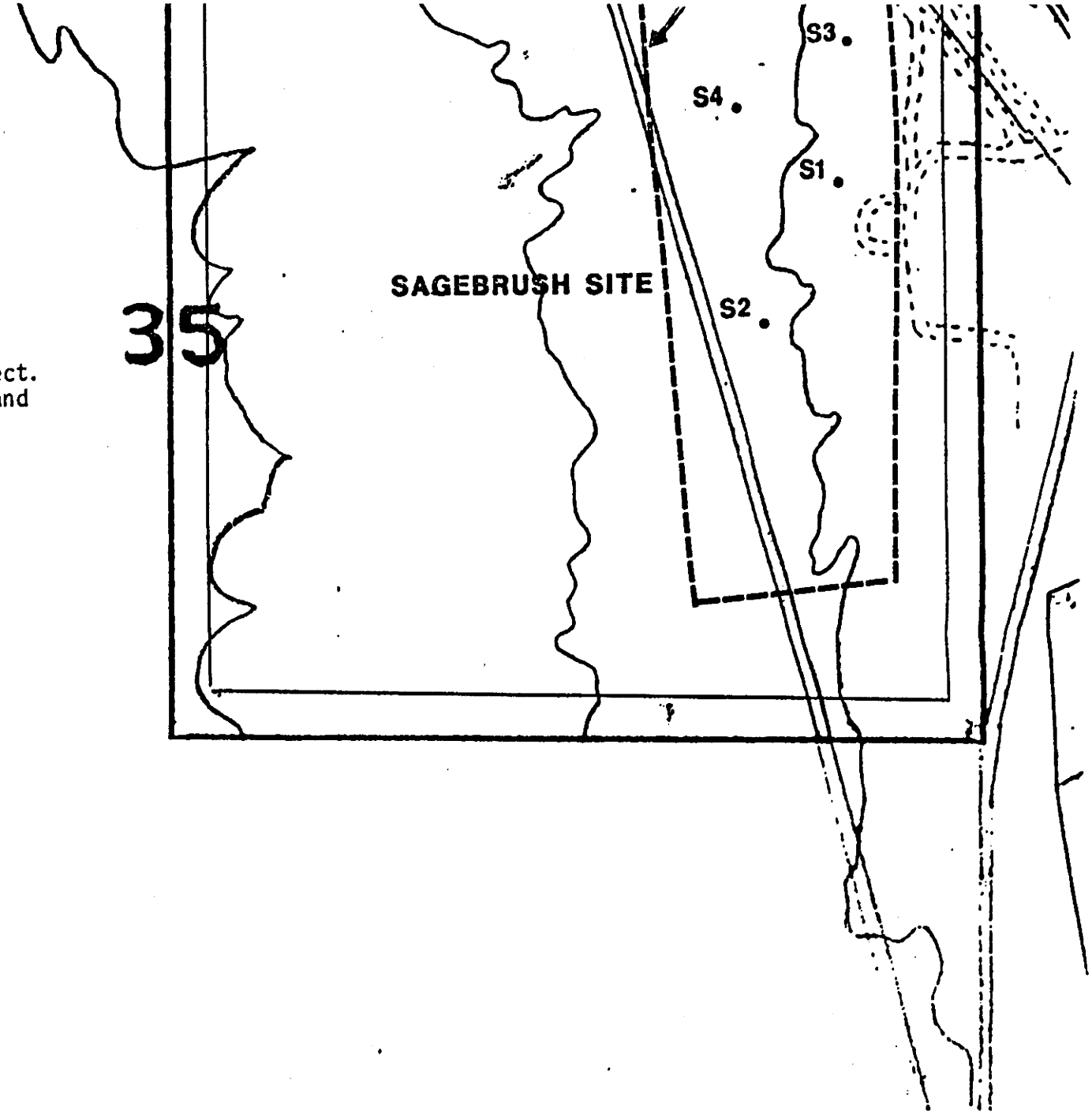

Figure 2. North Lily project. Vegetation sample sites and soil sample locations.

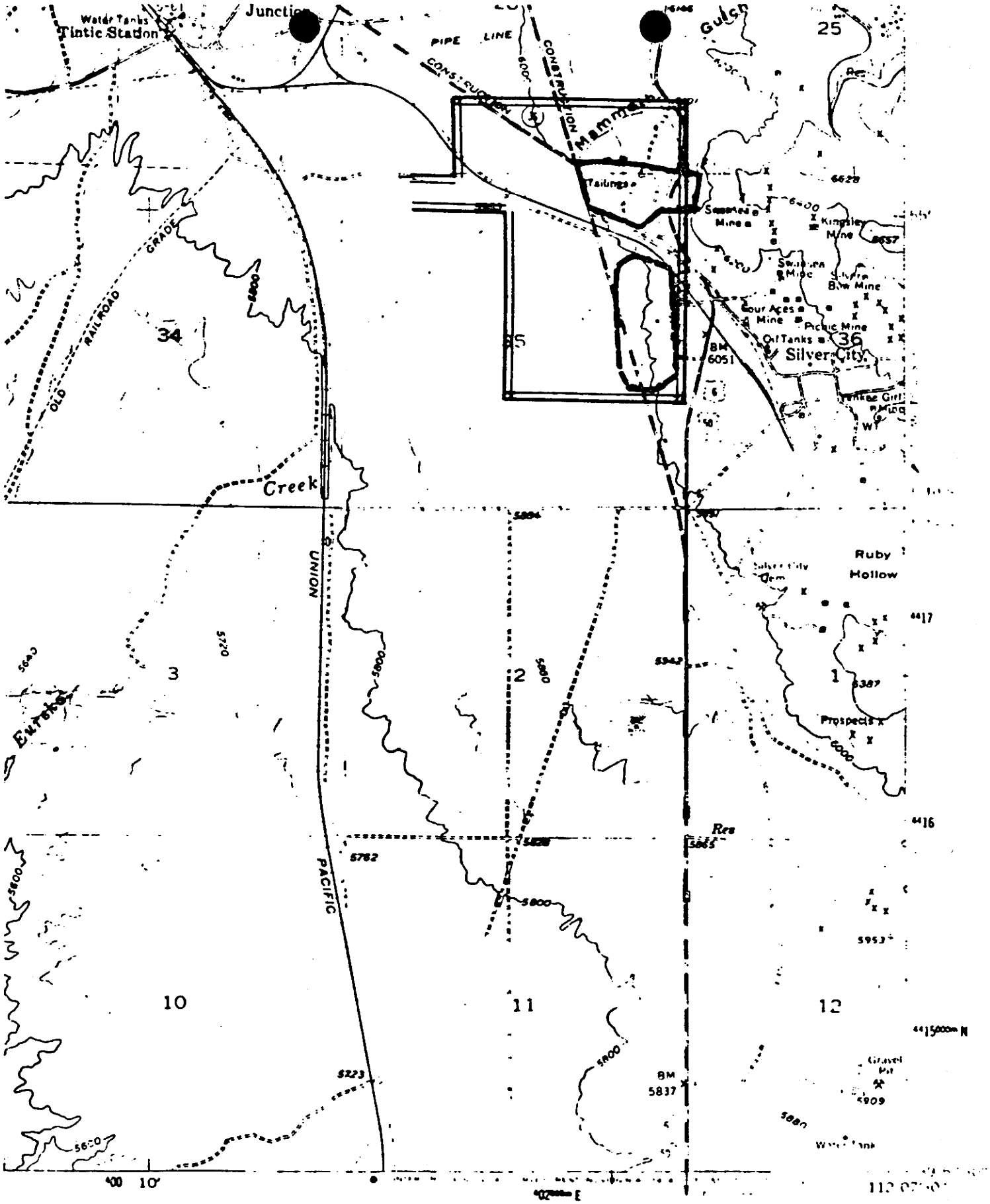

Figure 1. North Lily Project. Site location.

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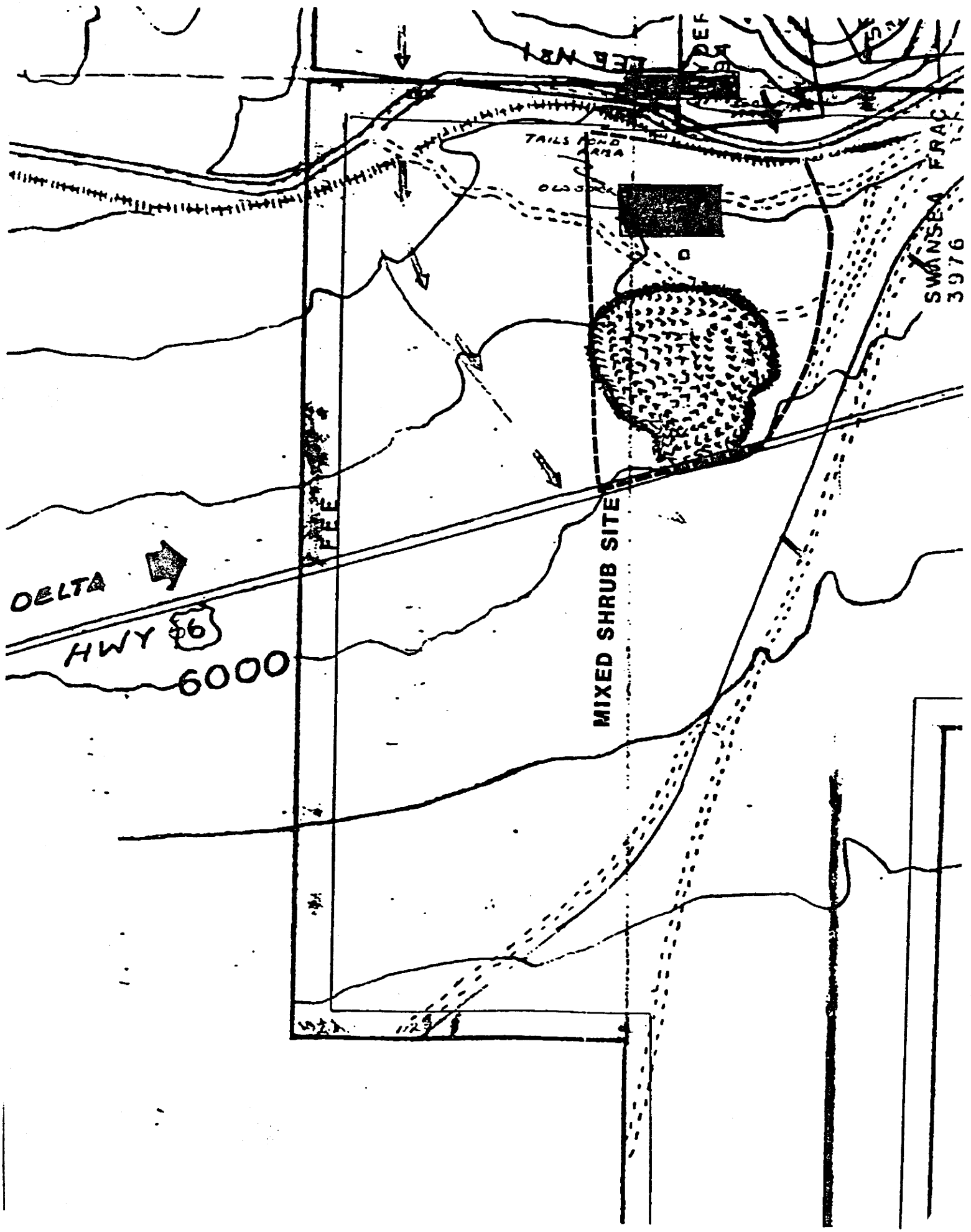
MIXED SHRUB SITE
DELTA
HWY 6
6000